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(71)Applicant : RICOH CO LTD

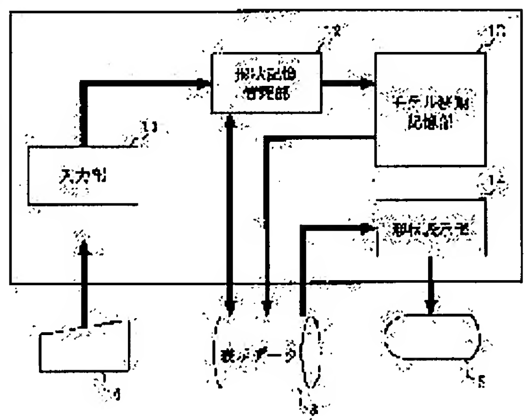
(72)Inventor : ARAGAKI KOJI

(54) THREE DIMENSIONAL SHAPE PROCESSOR AND THREE DIMENSIONAL SHAPE PROCESSING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a three dimensional shape processor or the like which can automatically create a plan in the state of decomposition or arrangement from a three dimensional shape model designed into product by using CAD or the like.

SOLUTION: In the three dimensional shape processor displaying a three dimensional shape model composed of a plurality of part models in accordance with display data, a model movement processing part 13 automatically detects physical relationship of face adjustment or shaft adjustment of part models each other, moves part models staying in that physical relationship so as to separate them each other, detects whether or not the model newly incurs an interference with other part models of the same layer during movement, and moves the model further to the position to avoid the interference in the same direction when interferencing.



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(71)出願人　000006747
株式会社リコー
東京都大田区中馬込１丁目３番６号
(72)発明者　新垣　恒治
東京都大田区中馬込１丁目３番６号　株式会社リコー内

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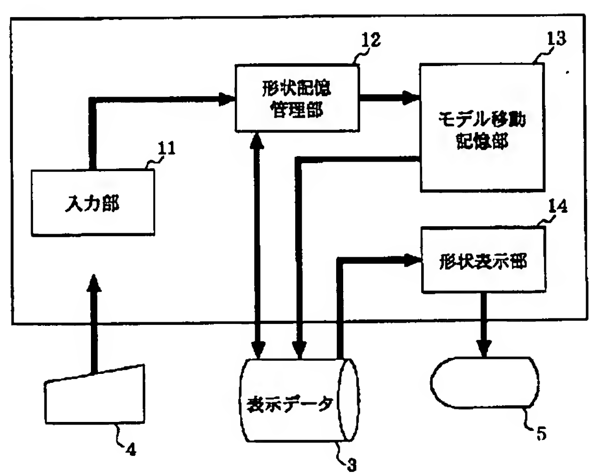
(54)【発明の名称】　３次元形状処理装置および３次元形状処理方法

(57)【要約】
【課題】　ＣＡＤなどを用いて製品設計した３次元形状モデルから、それが分解・配置された状態の図面を自動的に作成することができる３次元形状処理装置などを提供する。
【解決手段】　複数の部分モデルから構成される３次元形状モデルを表示データに従って表示する３次元形状処理装置において、モデル移動処理部１３が、部分モデル同士の面合わせまたは軸合わせの位置関係を自動的に検出し、その位置関係にある部分モデルを互いに引き離すように移動させ、その部分モデル移動の際に同一階層中の他の部分モデルと新たに干渉するか否かを検出し、干渉している場合には干渉を回避する位置までさらに同一方向に移動させる構成にした。



【特許請求の範囲】

【請求項１】　複数の部分モデルから構成される３次元形状モデルを表示データに従って表示する３次元形状処理装置において、部分モデル同士の面合わせまたは軸合わせの位置関係を自動的に検出し、その位置関係にある部分モデルを互いに引き離すように移動するモデル移動手段と、そのモデル移動手段による部分モデル移動の際に同一階層中の他の部分モデルと新たに干渉するか否かを検出し、干渉している場合には干渉を回避する位置までさらに同一方向に移動する処理を行う移動追加手段とを備えたことを特徴とする３次元形状処理装置。

【請求項２】　請求項１記載の３次元形状処理装置において、前記モデル移動手段は、アセンブリ階層中の深さが深い部分モデルから順に、前記アセンブリ階層中の各階層における部分モデル同士の干渉状態をチェックし、干渉している場合には干渉を回避する位置まで前記部分モデルを移動するように構成したことを特徴とする３次元形状処理装置。

【請求項３】　請求項１または請求項２記載の３次元形状処理装置において、部分モデル同士の干渉状態を直方体となる境界箱同士の位置関係により検出し、その境界箱の干渉領域の一番短い辺にあたるＸ方向、Ｙ方向、Ｚ方向いずれかの方向をモデル移動方向と決定する移動方向決定手段を備えたことを特徴とする３次元形状処理装置。

【請求項４】　請求項１、請求項２、または請求項３記載の３次元形状処理装置において、各部分モデルを１回目に移動する距離を利用者が指定するための距離指定手段を備えたことを特徴とする３次元形状処理装置。

【請求項５】　請求項１、請求項２、または請求項３記載の３次元形状処理装置において、前記各部分モデルを１回目に移動する距離を、移動する部分モデルの境界箱を定義する３次元空間上の８つの座標値を移動方向へ射影したときの座標値の位置の分布範囲の値から自動的に決定する構成にしたことを特徴とする３次元形状処理装置。

【請求項６】　複数の部分モデルから構成される３次元形状モデルを表示データに従って表示する３次元形状処理方法において、部分モデル同士の面合わせまたは軸合わせの位置関係を自動的に検出し、その位置関係にある部分モデルを互いに引き離すように移動したとき、同一階層中の他の部分モデルと新たに干渉するか否かを検出し、干渉している場合には干渉を回避する位置までさらに同一方向に移動する処理を行うことを特徴とする３次元形状処理方法。

【請求項７】　請求項５記載の３次元形状処理方法において、アセンブリ階層中の深さが深い部分モデルから順に、階層中の各階層における部分モデル同士の干渉状態をチェックし、干渉している場合には干渉を回避する位置まで部分モデルを移動することを特徴とする３次元形状処理方法。

【請求項８】　請求項７記載の３次元形状処理方法において、部分モデル同士の干渉状態を直方体となる境界箱同士の位置関係により検出し、その境界箱の干渉領域の一番短い辺にあたるＸ方向、Ｙ方向、Ｚ方向いずれかの方向をモデル移動方向と決定することを特徴とする３次元形状処理方法。

【請求項９】　請求項６、請求項７、または請求項８記載の３次元形状処理方法において、各部分モデルを１回目に移動する距離を利用者が指定できる構成にしたことを特徴とする３次元形状処理方法。

【請求項１０】　請求項６、請求項７、または請求項８記載の３次元形状処理方法において、各モデルを１回目に移動する距離を、移動する部分モデルの境界箱を定義する３次元空間上の８つの座標値を移動方向へ射影したときの座標値の位置の分布範囲の値から自動的に決定する構成にしたことを特徴とする３次元形状処理方法。

【請求項１１】　プログラムを記憶した記憶媒体において、請求項６乃至請求項１０のいずれかに記載の３次元形状処理方法に従ってプログラミングしたプログラムを記憶したことを特徴とする記憶媒体。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、３次元ＣＡＤ／ＣＡＭ／ＣＡＥ／ＣＧなど３次元形状処理を行なう専用の３次元形状処理装置やパーソナルコンピュータなど情報処理装置で実施される、記憶された３次元形状モデルを処理する３次元形状処理方法に係わり、特に、アセンブリを構成している部品やサブアセンブリなど部分モデルをアセンブリされた状態から互いに引き離して配置する際に、その部分モデル同士が干渉しないように容易に配置することができる３次元形状処理方法に関する。

【０００２】

【従来の技術】３次元ＣＡＤ／ＣＧシステムなどの普及により、３次元立体形状を表現した３次元形状データの利用者層が拡大している。近年は、シミュレーションや組み立て性の検証、さらには実際の製品組み立てのための作業手順書の作成などにおいても３次元形状データが有効に活用されている。なお、３次元立体形状とは、例えば境界表現形式のソリッドモデルデータとして生成された形状を指し、境界表現形式のソリッドモデルとは、稜線や頂点や面というような要素により３次元空間上に閉じた領域を定義し、中身の詰まった立体を表現したものである。例えば前記した組み立て手順書を作成する際には、製品を構成するサブアセンブリや部品を一定の間隔にばらして配置した様子を図示することが必要である。これまで、このような図面については、３次元立体形状を表現した２次元図面から専門家が手作業により作成してきた。しかし、２次元図面から手作業により前記した図面を作成するには多大なコストと時間がかかっ

た。また、図面が完成した後は、個々の部品を移動する距離や、モデルを見ているときの視点などだけを調整することが不可能であったので、完成した図面が所望のものでなかった場合には、図面を最初から作成し直さねばならなかった。一方、製品設計に利用したＣＡＤシステムを用いて個々の部品を移動した結果を表示し、それを図面に用いる方法も考えられるが、その場合、製品を構成する個々の部品をばらして適当な位置に配置する作業をＣＡＤシステムの利用者（操作者）が部品毎に行う必要があり、それを手作業で行うにはそれなりの時間を要する。なお、特開２０００−９０１２９公報に示されたレイアウト設計方法では、レイアウトされる部品の部品情報に配置制約条件や配置ルールを付加し、それらの情報を３次元形状データに変換した情報を用いて自動的にレイアウトし、さらに、レイアウトされた部品同士が重なるか否かを自動的に検査し、その検査結果に従って部品同士が重ならないように自動的に配置する。また、当出願者からは、ＣＡＤシステムなどを用いて製品設計したアセンブリを自動分解する際、アセンブリ位置から取り出される部品が残アセンブリにぶつからないように、最適経路を通って自動的に部品を取り出すようにした自動分解システムが提供されている。

【０００３】

【発明が解決しようとする課題】しかしながら、特開２０００−９０１２９公報に示されたレイアウト設計方法は組み立てのための方法であり、組み立てられた状態のアセンブリをサブアセンブリや部品レベルにばらした位置におけるサブアセンブリや部品同士の干渉については用いることができない。また、前記自動分解システムも、分解した（ばらした）部品を配置したりはしない。したがって、結局のところ、従来においては、部品をばらして配置した状態の図面を手作業により作成するということになり、その場合、前記したように、多大なコストと時間がかかるという問題があるし、図面が完成した後は、個々の部品を移動する距離や、モデルを見ているときの視点などだけを調整することが不可能であるという問題がある。本発明の目的は、このような従来技術の問題を解決することにあり、具体的には、ＣＡＤなどを用いて製品設計した３次元モデルから、それが分解・配置された状態の図面を自動的に作成できる３次元形状処理方法を提供することにある。また、アセンブリを構成する個々の部品の移動距離を調整しながら試行錯誤することができ、その際、必要な計算はすべて自動的に行うことができる３次元形状処理方法を提供することにある。

【０００４】

【課題を解決するための手段】前記の課題を解決するために、請求項１記載の発明では、複数の部分モデルから構成される３次元形状モデルを表示データに従って表示する３次元形状処理装置において、部分モデル同士の面合わせまたは軸合わせの位置関係を自動的に検出し、その位置関係にある部分モデルを互いに引き離すように移動するモデル移動手段と、そのモデル移動手段による部分モデル移動の際に同一階層中の他の部分モデルと新たに干渉するか否かを検出し、干渉している場合には干渉を回避する位置までさらに同一方向に移動する処理を行う移動追加手段とを備えたことを特徴とする。また、請求項２記載の発明では、請求項１記載の発明において、アセンブリ階層中の深さが深い部分モデルから順に、アセンブリ階層中の各階層における部分モデル同士の干渉状態をチェックし、干渉している場合には干渉を回避する位置まで部分モデルを移動するように前記モデル移動手段を構成したことを特徴とする。また、請求項３記載の発明では、請求項１または請求項２記載の発明において、部分モデル同士の干渉状態を直方体となる境界箱同士の位置関係により検出し、その境界箱の干渉領域の一番短い辺にあたるＸ方向、Ｙ方向、Ｚ方向いずれかの方向をモデル移動方向と決定する移動方向決定手段を備えたことを特徴とする。また、請求項４記載の発明では、請求項１、請求項２、または請求項３記載の発明において、各部分モデルを１回目に移動する距離を利用者が指定するための距離指定手段を備えたことを特徴とする。また、請求項５記載の発明では、請求項１、請求項２、または請求項３記載の発明において、各モデルを１回目に移動する距離を、移動する部分モデルの境界箱を定義する３次元空間上の８つの座標値を移動方向へ射影したときの座標値の位置の分布範囲の値から自動的に決定する構成にしたことを特徴とする。

【０００５】また、請求項６記載の発明では、複数の部分モデルから構成される３次元形状モデルを表示データに従って表示する３次元形状処理方法において、部分モデル同士の面合わせまたは軸合わせの位置関係を自動的に検出し、その位置関係にある部分モデルを互いに引き離すように移動したとき、同一階層中の他の部分モデルと新たに干渉するか否かを検出し、干渉している場合には干渉を回避する位置までさらに同一方向に移動する処理を行う構成にしたことを特徴とする。また、請求項７記載の発明では、請求項５記載の発明において、アセンブリ階層中の深さが深い部分モデルから順に、階層中の各階層における部分モデル同士の干渉状態をチェックし、干渉している場合には干渉を回避する位置まで部分モデルを移動する構成にしたことを特徴とする。また、請求項８記載の発明では、請求項７記載の発明において、部分モデル同士の干渉状態を直方体となる境界箱同士の位置関係により検出し、その境界箱の干渉領域の一番短い辺にあたるＸ方向、Ｙ方向、Ｚ方向いずれかの方向をモデル移動方向と決定する構成にしたことを特徴とする。また、請求項９記載の発明では、請求項６、請求項７、または請求項８記載の発明において、各部分モデルを１回目に移動する距離を利用者が指定できる構成に

したことを特徴とする。また、請求項１０記載の発明では、請求項６、請求項７、または請求項８記載の発明において、各モデルを１回目に移動する距離を、移動する部分モデルの境界箱を定義する３次元空間上の８つの座標値を移動方向へ射影したときの座標値の位置の分布範囲の値から自動的に決定する構成にしたことを特徴とする。また、請求項１１記載の発明では、プログラムを記憶した記憶媒体において、請求項６乃至請求項１０のいずれかに記載の３次元形状処理方法に従ってプログラミングしたプログラムを記憶したことを特徴とする。

【０００６】

【発明の実施の形態】以下、図面により本発明の実施の形態を詳細に説明する。図１は本発明が実施される３次元形状処理装置のハードウェア構成図である。図示したように、この３次元形状処理装置は、本発明に係わる３次元形状処理やこの装置全体の制御をプログラムに従って実行するＣＰＵ１、プログラムやデータを一時的に記憶するメモリ（例えばＲＡＭ）２、プログラムやデータを記憶しておく外部記憶装置（例えばハードディスク装置）３、操作情報や３次元形状データを入力する入力装置４、アセンブリされた３次元立体形状のモデルやそれが分解されたサブアセンブリや部品など部分モデルを表示する表示装置５、およびそれらを図示のように接続するバス６を備える。また、図２は、本発明の一実施例を示す３次元形状処理装置要部のシステム構成図である。図示したように、この３次元形状処理装置は、それぞれ前記ハードウェアとプログラムにより実現される、操作情報や３次元形状データを入力させる入力部１１、３次元形状データを外部記憶装置３に記憶させたり３次元形状データを管理したりする形状記憶管理部１２、アセンブリされた状態からサブアセンブリや部品など部分モデルを引き離して移動させるモデル移動処理部１３、アセンブリされた３次元立体形状のモデルやそれが分解されたサブアセンブリや部品など部分モデルを表示させる形状表示部１４などを備える。なお、この実施例では、請求項記載のモデル移動手段、移動追加手段、および移動方向決定手段は前記モデル移動処理部１３により実現され、距離指定手段は入力部１１により実現される。

【０００７】図３に、このような３次元形状処理装置により実行される、この実施例の動作フローを示す。以下、図３に従って、この実施例の動作を説明する。まず、共通の親（サブアセンブリ）をもつ例えば複数の部品について、モデル移動処理部１３は、部品間に面合わせまたは軸合わせの位置関係があるか否かを検出する（Ｓ１）。なお、部品同士が面合わせの位置関係にあることを検出するには、法線ベクトルが逆向きで、その一部または全体を３次元空間内で共有する位置関係にある平面が存在するか否かを判定するといった一般的に知られた方法を用いればよい。また、部品同士が軸合わせの位置関係にあることを検出するには、例えば軸が３次元空間上で一致している円柱面や円錐面、または円弧稜線が存在するか否かという方法を用いればよい。そして、面合わせや軸合わせの位置関係にある部品が検出されたならば（Ｓ２でＹＥＳ）、モデル移動処理部１３はその法線ベクトルや軸の方向に部分モデル（この例では部品）を移動させる（Ｓ３）。なお、移動距離は入力部１１により利用者が予め与えるようにしてもよいし、移動する部品の境界箱（当該部品に外接する直方体）を構成する８つの点の３次元空間上の座標値を移動方向へ射影したときの射影面における座標値の分布範囲の長さから自動的に決定してもよい。つまり、移動する部品が大きいほど移動量を大きくするのである。各部分モデルを移動させた後、モデル移動処理部１３は共通の親をもつ他の部分モデル（サブアセンブリや部品）と新たに干渉する（重なる）か否かを検出する（Ｓ４）。そして、干渉している場合には（Ｓ４でＹＥＳ）、干渉しなくなる位置までさらに同一方向にモデルを移動させる（Ｓ５）。

【０００８】図４に、以上の処理（自動部品移動と呼ぶ）をアセンブリ階層全体に対して実施する動作フローを示す。なお、以下の説明で深さとは、アセンブリ階層木中のｒｏｏｔ（例えば最上位のアセンブリ）からそのｎｏｄｅ（当該サブアセンブリまたは部品）へ至るまでの階層数という意味である。また、深さが深いということは、階層木中でｒｏｏｔから遠く、階層数が大であるという意味である。図４に示したように、まず、アセンブリ階層木を深さ優先（深い順）で探索するときの順からみて、順序が最初となる最深部のリーフの位置に存在する部品を含むサブアセンブリ（以下、Ａと呼ぶ）から自動部品移動を実施する（Ｓ１１）。また、Ａの１つ上位に位置するサブアセンブリ（以下、Ｂと呼ぶ）に注目したとき、Ｂの下にＡ以外のサブアセンブリや部品が存在する場合には、それらのサブアセンブリや部品についても同様に自動部品移動を行う（Ｓ１１）。こうして、Ｂに含まれるすべての部分モデル（サブアセンブリや部品）の自動部品移動が終了したとき、そのすべての部分モデルについて、境界箱同士が干渉するか否かを検出する（Ｓ１２）。そして、干渉している部分モデルがある場合には（Ｓ１３でＹＥＳ）、部分モデル同士が干渉しないように移動する（Ｓ１４）。移動する部分モデルの選択およびその部分モデルを動かす方向の決定については、例えば必ずＸ方向に２つのモデルを引き離すように処理してもよいし、直方体となる境界箱の干渉領域（これは立体領域である）の３辺のうち一番短い辺にあたるＸ、Ｙ、またはＺ方向にモデルを移動してもよい。後者の方法では、干渉を回避しながら部分モデルの移動距離を最小限におさえることができる。Ｂの１つ上位に位置するサブアセンブリ（以下、Ｃと呼ぶ）があって、Ｃの下にＢ以外のサブアセンブリが存在する場合には（Ｓ１５でＮＯ）、Ｃをｒｏｏｔと仮定した部分木からＢを除いた構成内で、その下の最深部に位置する部品を

含むサブアセンブリか[illegible]同様に自動部品移動を実施する（Ｓ１１～Ｓ１４）。また、以上のように処理してアセンブリ階層の最上位にまで到達したら（Ｓ１５でＹＥＳ）処理を終了する。こうして、この実施例によれば、階層を辿りながら処理することにより、アセンブリ全体にわたって全ての構成要素間に一切の干渉のない状態で、当該アセンブリが分解・配置された様子を表示することが可能になる。なお、当該アセンブリが分解・配置された様子をプロッタにより紙上に出力することも可能である。以上、本発明の一実施例について説明したが、説明したような３次元形状処理方法に従ってプログラミングしたプログラムを例えば着脱可能な記憶媒体に記憶し、その記憶媒体をこれまで本発明によった３次元形状処理を行えなかったパーソナルコンピュータなど情報処理装置に装着することにより、その情報処理装置においても本発明によった３次元形状処理を行うことができる。また、前記プログラムをこれまで本発明によった３次元形状処理を行えなかった情報処理装置へネットワークを介して転送することにより、その情報処理装置においても本発明によった３次元形状処理を行うことができる。

【０００９】

【発明の効果】以上説明したように、本発明によれば、請求項１および請求項６記載の発明では、複数の部分モデルから構成される３次元形状モデルを表示データに従って表示する３次元形状処理において、部分モデル同士の面合わせまたは軸合わせの位置関係が自動的に検出され、その位置関係にある部分モデルを互いに引き離すように移動したとき、同一階層中の他の部分モデルと新たに干渉するか否かが検出され、干渉している場合には干渉を回避する位置までさらに同一方向に移動する処理が行われるので、ＣＡＤなどを用いて製品設計した３次元モデルから、それが分解・配置された状態の図面を自動的に作成できるし、アセンブリを構成する個々の部品の移動距離を調整しながら試行錯誤することができ、その際、必要な計算はすべて自動的に行うことができる。また、請求項２および請求項７記載の発明では、請求項１または請求項５記載の発明において、アセンブリ階層中の深さが深い部分モデルから順に、階層中の各階層における部分モデル同士の干渉状態がチェックされ、干渉している場合には干渉を回避する位置まで部分モデルが移動されるので、アセンブリ全体について全ての構成要素間に干渉が一切ない状態で、当該アセンブリが分解された様子を表示・図面化することができる。また、請求項３および請求項８記載の発明では、請求項２または請求項７記載の発明において、部分モデル同士の干渉状態が直方体となる境[illegible]同士の位置関係により検出され、その境界箱の干渉領域の一番短い辺にあたるＸ方向、Ｙ方向、Ｚ方向いずれかの方向がモデル移動方向とされるので、アセンブリ全体について全ての構成要素間に干渉が一切ない状態で、当該アセンブリが分解された様子を表示・図面化することができるし、部分モデルを移動する際、その移動距離を最小限に抑えることができる。

【００１０】また、請求項４および請求項９記載の発明では、請求項１乃至請求項３、請求項６乃至請求項８のいずれかに記載の発明において、各部分モデルを１回目に移動する距離を利用者が指定できるので、アセンブリを分解する程度を利用者が調整しながら試行錯誤することができる。また、請求項５および請求項１０記載の発明では、請求項１乃至請求項３、請求項６乃至請求項８のいずれかに記載の発明において、各モデルを１回目に移動する距離が、移動する部分モデルの境界箱を定義する３次元空間上の８つの座標値を移動方向へ射影したときの座標値の位置の分布範囲の値から自動的に決定されるので、作業がより簡単になる。また、請求項１１記載の発明では、請求項６乃至請求項１０のいずれかに記載の３次元形状処理方法に従ってプログラミングしたプログラムが例えば着脱可能な記憶媒体に記憶されるので、その記憶媒体をこれまで請求項６乃至請求項１０のいずれかに記載の発明によった３次元形状処理を行えなかったパーソナルコンピュータなど情報処理装置に装着することにより、その情報処理装置においても請求項６乃至請求項１０のいずれかに記載の発明の効果を得ることができる。

【図面の簡単な説明】

【図１】本発明が実施される３次元形状処理装置のハードウェア構成図である。

【図２】本発明の一実施例を示す３次元形状処理装置要部のシステム構成図である。

【図３】本発明の一実施例を示す３次元形状処理方法の動作フロー図である。

【図４】本発明の一実施例を示す３次元形状処理方法の他の動作フロー図である。

【符号の説明】

１　ＣＰＵ

３　外部記憶装置

４　入力装置

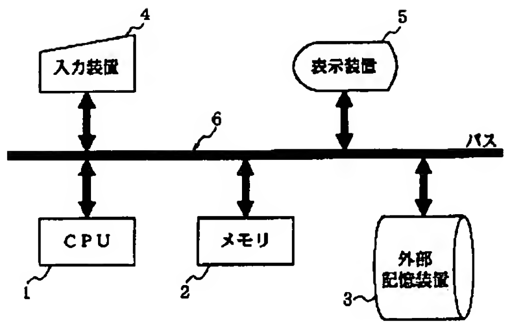
５　表示装置

１１　入力部

１３　モデル移動処理部

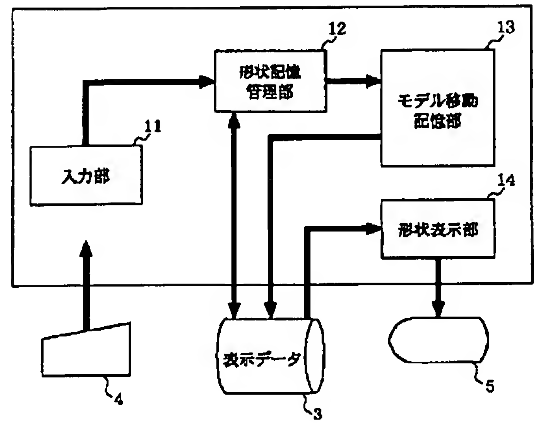
１４　形状表示部

【図1】



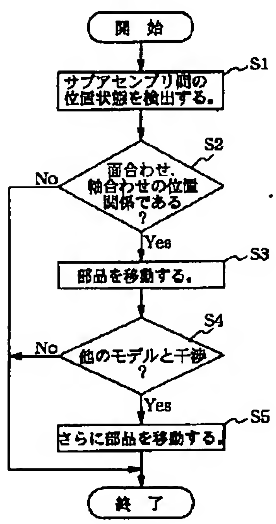
4
入力装置
5
表示装置
6
バス
CPU
メモリ
外部記憶装置
1
2
3

【図2】



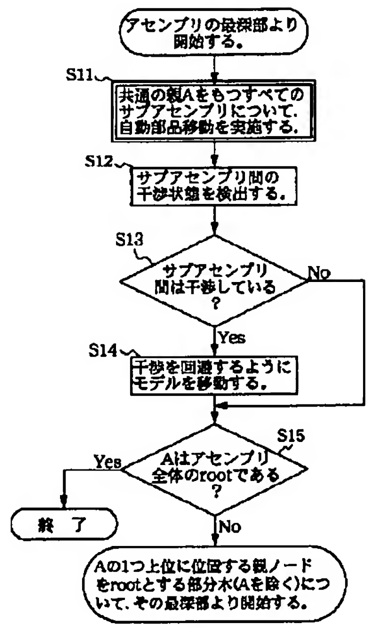
12
形状記憶管理部
13
モデル移動記憶部
11
入力部
14
形状表示部
表示データ
4
3
5

【図3】



開 始
サブアセンブリ間の位置状態を検出する。
S1
面合わせ、軸合わせの位置関係である？
S2
No
Yes
部品を移動する。
S3
他のモデルと干渉？
S4
No
Yes
さらに部品を移動する。
S5
終 了

【図4】



アセンブリの最深部より開始する。
S11
共通の親Aをもつすべてのサブアセンブリについて、自動部品移動を実施する。
S12
サブアセンブリ間の干渉状態を検出する。
S13
サブアセンブリ間は干渉している？
No
Yes
S14
干渉を回避するようにモデルを移動する。
S15
Aはアセンブリ全体のrootである？
Yes
終 了
No
Aの1つ上位に位置する親ノードをrootとする部分木(Aを除く)について、その最深部より開始する。

CLAIMS

[Claim(s)]

[Claim 1] In the three-dimension configuration processor which displays the three-dimension geometric model which consists of two or more partial models according to an indicative data A model migration means to move so that the partial model which detects automatically the physical relationship of field doubling of partial models or axial doubling, and is in the physical relationship may be pulled apart mutually, The three-dimension configuration processor characterized by having a migration addition means to perform processing which moves in the same direction further to the location which avoids interference when detecting whether it newly interferes with other partial models in the same hierarchy and having interfered in it in the case of the partial model migration by the model migration means.

[Claim 2] It is the three-dimension configuration processor which said model migration means checks the interference condition of the partial models in each hierarchy in said assembly hierarchy in order from a partial model with the deep depth in an assembly hierarchy in a three-dimension configuration processor according to claim 1, and is characterized by constituting so that said partial model may be moved to the location which avoids interference when having interfered.

[Claim 3] The three-dimension configuration processor characterized by having a migration direction decision means to determine the direction of the direction of X which detects the interference condition of partial models according to the physical relationship of boundary boxes used as a rectangular parallelepiped in a three-dimension configuration processor according to claim 1 or 2, and hits the shortest side of the interference region of the boundary box, the direction of Y, or a Z direction as the model migration direction.

[Claim 4] The three-dimension configuration processor characterized by having a distance assignment means for a user specifying the distance which moves each partial model to the 1st time in claim 1, claim 2, or a three-dimension configuration processor according to claim 3.

[Claim 5] The three-dimension configuration processor characterized by making eight coordinate values on the three-dimension space which defines the boundary box of a partial model which moves the distance which moves said each partial model to the 1st time in claim 1, claim 2, or a three-dimension configuration processor according to claim 3 the configuration for which it opts automatically from the value of the range of the location of the coordinate value when projecting in the migration direction.

[Claim 6] In the three-dimension configuration art which displays the three-dimension geometric model which consists of two or more partial models according to an indicative data When it moves so that the partial model which detects automatically the physical relationship of field doubling of partial models or axial doubling, and is in the physical relationship may be pulled apart mutually, The three-dimension configuration art characterized by performing processing which moves in the same direction further to the location which avoids interference when detecting whether it newly interferes with other partial models in the same hierarchy and having interfered in it.

[Claim 7] The three-dimension configuration art which checks the interference condition of the partial models in each hierarchy in a hierarchy in order from a partial model with the deep depth in an assembly hierarchy, and is characterized by moving a partial model to the location which avoids interference when having interfered in a three-dimension configuration art according to claim 5.

[Claim 8] The three-dimension configuration art characterized by determining the direction of the direction of X which detects the interference condition of partial models according to the physical relationship of boundary boxes used as a rectangular parallelepiped in a three-dimension configuration art according to claim 7, and hits the shortest side of the interference region of the boundary box, the direction of Y, or a Z direction as the model migration direction.
[Claim 9] The three-dimension configuration art characterized by making distance which moves each partial model to the 1st time the configuration which a user can specify in claim 6, claim 7, or a three-dimension configuration art according to claim 8.
[Claim 10] The three-dimension configuration art characterized by making eight coordinate values on the three-dimension space which defines the boundary box of a partial model which moves the distance which moves each model to the 1st time in claim 6, claim 7, or a three-dimension configuration art according to claim 8 the configuration for which it opts automatically from the value of the range of the location of the coordinate value when projecting in the migration direction.
[Claim 11] The storage characterized by memorizing the program programmed according to the three-dimension configuration art according to claim 6 to 10 in the storage which memorized the program.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] In case partial models, such as components, a subassembly, etc. which constitute the assembly especially, are mutually pulled apart from the condition by which the assembly was carried out and this invention arranges them with respect to the three-dimension configuration art which is enforced with information processors, such as a three-dimension configuration processor, a personal computer, etc. of dedication which perform three-dimension configuration processings, such as three dimensional CAD/CAM/CAE/CG, and which processes the memorized three-dimension geometric model, it relates to the three-dimension configuration art which can arrange easily so that the partial models may not interfere.
[0002]
[Description of the Prior Art] By the spread of three dimensional CAD / CG systems, the user layer of the three-dimension configuration data expressing a three-dimension solid configuration is expanded. In recent years, also in creation of the work procedure instruction sheet for verification of simulation or assembly nature, and a still more nearly actual product assembly etc., three-dimension configuration data are utilized effectively. In addition, a three-dimension solid configuration points out the configuration generated as solid model data of for example, a boundary representation format, the field closed on three-dimension space with an element, such as a ridgeline, top-most vertices, and a field, is defined, and the stereo with which contents were got blocked is expressed as the solid model of a boundary representation format. For example, in case the above mentioned assembly procedure is drawn up, it is required to illustrate signs that the subassembly and components which constitute a product have been taken into pieces and arranged at fixed spacing. About such a drawing, the expert has so far created by handicraft from the two-dimensional drawing expressing a three-dimension solid configuration. However, creating the drawing described above by handicraft from the two-dimensional drawing took great cost and time amount. Moreover, when the completed drawing was not a desired thing since it was impossible to have adjusted the distance which moves each components, a view when seeing the model, etc. after a drawing is completed, the drawing had to be re-created from the beginning. Although the method of displaying the result of on the other hand having moved each components using the CAD system used for the product design, and using it for a drawing is also considered, the user (operator) of a CAD system needs to do the activity which takes into pieces each components which constitute a product in that case, and is arranged in a suitable location for every components, and appropriate time amount is required for performing it manually. In addition, by the layout design approach shown in the JP,2000-90129,A official report, an arrangement constraint and the arrangement Ruhr are added to the components information on the components arranged, and it arranges automatically using the information which changed those information into three-dimension configuration data, and it inspects automatically whether the arranged components lap, and further, it arranges automatically so that components may not lap according to the inspection result. Moreover, from this applicant, in case the assembly which carried out the product design using the CAD system etc. is understood by automatic, the automatic decomposition system which took out components automatically through the optimal path is offered so that the components taken out from an assembly location may not collide with a ** assembly.

[0003]
[Problem(s) to be Solved by the Invention] However, the layout design approach shown in the JP,2000-90129,A official report is an approach for an assembly, and cannot be used about interference of the subassembly in the location which took into pieces the assembly in the condition of having been assembled, on a subassembly or components level, or components. Moreover, that said automatic decomposition system also arranges the disassembled components (it took into pieces) **** does not carry out. Therefore, it sets to the former despite a join office. As the drawing in the condition of having taken into pieces and arranged components will be referred to as creating by handicraft and was described above in that case There is a problem of taking great cost and time amount, and after a drawing is completed, there is a problem that it is impossible to adjust the distance which moves each components, a view when seeing the model, etc. The purpose of this invention is to solve the problem of such a conventional technique, and, specifically, it is from the three-dimension model which carried out the product design using CAD etc. to offer the three-dimension configuration art which can create automatically the drawing in the condition of having been decomposed and arranged. Moreover, a trial-and-error method can be applied adjusting the migration length of each components which constitute an assembly, and it is in offering the three-dimension configuration art which can perform all required count automatically in that case.
[0004]
[Means for Solving the Problem] In order to solve the aforementioned technical problem, in invention according to claim 1 In the three-dimension configuration processor which displays the three-dimension geometric model which consists of two or more partial models according to an indicative data A model migration means to move so that the partial model which detects automatically the physical relationship of field doubling of partial models or axial doubling, and is in the physical relationship may be pulled apart mutually, When detecting whether it newly interferes with other partial models in the same hierarchy and having interfered in it in the case of the partial model migration by the model migration means, it is characterized by having a migration addition means to perform processing which moves in the same direction further to the location which avoids interference. Moreover, in invention according to claim 2, in invention according to claim 1, the interference condition of the partial models in each hierarchy in an assembly hierarchy is checked in order from a partial model with the deep depth in an assembly hierarchy, and when having interfered, it is characterized by constituting said model migration means so that a partial model may be moved to the location which avoids interference. Moreover, in invention according to claim 3, in invention according to claim 1 or 2, the physical relationship of boundary boxes used as a rectangular parallelepiped detects the interference condition of partial models, and it is characterized by having a migration direction decision means to determine the direction of the direction of X which hits the shortest side of the interference region of the boundary box, the direction of Y, or a Z direction as the model migration direction. Moreover, in invention according to claim 4, it is characterized by having a distance assignment means for a user specifying the distance which moves each partial model to the 1st time in claim 1, claim 2, or invention according to claim 3. Moreover, it is characterized by making eight coordinate values on the three-dimension space which defines by invention according to claim 5 the boundary box of a partial model which moves the distance which moves each model to the 1st time in claim 1, claim 2, or invention according to claim 3 the configuration for which it opts automatically from the value of the range of the location of the coordinate value when projecting in the migration direction.
[0005] Moreover, it sets to the three-dimension configuration art which displays the three-dimension geometric model which consists of two or more partial models in invention according to claim 6 according to an indicative data. When it moves so that the partial model which detects automatically the physical relationship of field doubling of partial models or axial doubling, and is in the physical relationship may be pulled apart mutually, When detecting whether it newly interferes with other partial models in the same hierarchy and having interfered in it, it is characterized by making it the configuration which performs processing which moves in the same direction further to the location which avoids interference. Moreover, in invention according to claim 7, in invention according to claim 5, the interference condition of the partial models in each hierarchy in a hierarchy is checked in order from a partial model with the deep depth in an assembly hierarchy, and when having interfered, it is characterized by making it the configuration which moves a partial model to the location

which avoids interference. Moreover, in invention according to claim 8, in invention according to claim 7, the physical relationship of boundary boxes used as a rectangular parallelepiped detects the interference condition of partial models, and it is characterized by making the direction of the direction of X which hits the shortest side of the interference region of the boundary box, the direction of Y, or a Z direction the configuration determined as the model migration direction. Moreover, in invention according to claim 9, it is characterized by making distance which moves each partial model to the 1st time the configuration which a user can specify in claim 6, claim 7, or invention according to claim 8. Moreover, it is characterized by making eight coordinate values on the three-dimension space which defines by invention according to claim 10 the boundary box of a partial model which moves the distance which moves each model to the 1st time in claim 6, claim 7, or invention according to claim 8 the configuration for which it opts automatically from the value of the range of the location of the coordinate value when projecting in the migration direction. Moreover, in invention according to claim 11, it is characterized by memorizing the program programmed according to the three-dimension configuration art according to claim 6 to 10 in the storage which memorized the program.
[0006]
[Embodiment of the Invention] Hereafter, a drawing explains the gestalt of operation of this invention to a detail. Drawing 1 is the hardware configuration Fig. of the three-dimension configuration processor with which this invention is carried out. As illustrated, this three-dimension configuration processor The three-dimension configuration processing concerning this invention, and control of this whole equipment CPU1, and the program and data which are performed according to a program The memory memorized temporarily (For example, RAM) 2, a program, and data The display 5 which displays partial models, such as a subassembly, components, etc. with which the model of the external storage (for example, hard disk drive unit) 3 to memorize, the input device 4 which inputs actuation information and three-dimension configuration data, and the three-dimension solid configuration by which the assembly was carried out, and it were decomposed, and them It has the bus 6 connected like illustration. Moreover, drawing 2 is the system configuration Fig. of a three-dimension configuration processor important section showing one example of this invention. As illustrated, this three-dimension configuration processor Said hardware and program realize, respectively. Partial models, such as a subassembly and components, are pulled apart from the input section 11 into which actuation information and three-dimension configuration data are made to input, the shape memory Management Department 12 which three-dimension configuration data are stored in external storage 3, or manages three-dimension configuration data, and the condition by which the assembly was carried out. It has the configuration display 14 on which partial models, such as a subassembly, components, etc. with which the model of the model migration processing section 13 to which it is made to move, and the three-dimension solid configuration by which the assembly was carried out, and it were decomposed, are displayed. In addition, in this example, a model migration means given in a claim, a migration addition means, and the migration direction decision means are realized by said model migration processing section 13, and a distance assignment means is realized by the input section 11.
[0007] The flow of this example of operation performed with such a three-dimension configuration processor by drawing 3 is shown. Hereafter, actuation of this example is explained according to drawing 3 . First, it detects whether the model migration processing section 13 has the physical relationship of field doubling or axial doubling among components, for example about two or more components with common parents (subassembly) (S1). In addition, what is necessary is just to use the method of judging whether the flat surface which has a normal vector in the physical relationship which shares the part or whole between the reverse sense in three-dimension space exists generally learned, in order to detect that components are in the physical relationship of field doubling. Moreover, what is necessary is just to use how the cylinder side whose shaft corresponds on three-dimension space, a conical surface, or a radii ridgeline exists, in order to detect that components are in the physical relationship of axial doubling. And if the components in the physical relationship of field doubling or axial doubling are detected (it is YES at S2), the model migration processing section 13 will move a partial model (this example components) to that normal vector and shaft orientation (S3). In addition, a user may be make to give migration length beforehand by the input section 11, and it may be automatically determine from the die length of the range of the coordinate value in the projecting plane

when project the coordinate value on the three dimension space of eight points which constitute the boundary box (rectangular parallelepiped circumscribe to the component concerned) of the components which move in the migration direction. That is, movement magnitude is enlarged, so that the components which move are large. After moving each partial model, the model migration processing section 13 detects whether it is newly interfering with other partial models (a subassembly and components) with common parents (it laps) (S4). And when having interfered, a model is further moved in the same direction by (S4 to YES) and the location in which it stops interfering (S5).

[0008] The flow of operation which carries out the above processing (it is called automatic components migration) to the whole assembly hierarchy to drawing 4 is shown. In addition, the depth is the semantics of the number of hierarchies until it results from root in an assembly hierarchy tree (for example, the top assembly) to the node (the subassembly concerned or components) in the following explanation. Moreover, that the depth is deep means that the long distance from root and the number of hierarchies are size in a hierarchy tree. As shown in drawing 4 , automatic components migration is first carried out from the subassembly (hereafter referred to as A) containing the components which exist in the location of the leaf of the deepest part with which sequence serves as the beginning, in view of the order when searching a depth first (deep order) for an assembly hierarchy tree (S11). Moreover, when the subassembly (hereafter referred to as B) located in one high order of A is observed and the subassembly and components other than A exist under B, automatic components migration is similarly performed about those subassembly and components (S11). In this way, when automatic components migration of all the partial models (a subassembly and components) contained in B is completed, it detects whether boundary boxes interfere about all those partial models (S12). And when there is a partial model in which it has interfered, it moves so that YES) and partial models may not interfere by (S13 (S14). About the decision of the direction from which selection of the partial model which moves, and its partial model are moved, you may process so that two models may always be pulled apart, for example in the direction of X, and it hits the shortest side among three sides of the interference region (this is a solid field) of the boundary box used as a rectangular parallelepiped. X, Y, or Z A model may be moved to a direction. By the latter approach, the migration length of a partial model can be pressed down to the minimum, avoiding interference. When there is a subassembly (hereafter referred to as C) located in one high order of B and subassemblies other than B exist under C, automatic components migration is completely similarly carried out from the subassembly which contains the components located in the deepest part under it within the configuration excluding B from the subtree which assumed NO) and C to be root by (S15 (S11-S14). Moreover, processing will be ended, if it processes as mentioned above and even an assembly hierarchy's most significant is reached (it is YES at S15). In this way, according to this example, it becomes possible by processing following a hierarchy to display signs that the assembly concerned has been decomposed and arranged, in the condition that there is none of all interference among all components over the whole assembly. In addition, it is also possible to output signs that the assembly concerned has been decomposed and arranged in the paper by the plotter. As mentioned above, although one example of this invention was explained, also in the information processor, three-dimension configuration processing by this invention can be performed by memorizing the program programmed according to a three-dimension configuration art which was explained, for example to a removable storage, and equipping information processors, such as a personal computer which was not able to perform three-dimension configuration processing according the storage to this invention until now. Moreover, also in the information processor, three-dimension configuration processing by this invention can be performed by transmitting to the information processor which was not able to perform three-dimension configuration processing according said program to this invention until now through a network.

[0009]

[Effect of the Invention] As explained above, according to this invention, in claim 1 and invention according to claim 6 In the three-dimension configuration processing which displays the three-dimension geometric model which consists of two or more partial models according to an indicative data When it moves so that the partial model which the physical relationship of field doubling of partial models or axial doubling is automatically detected, and has it in the physical relationship may be pulled apart mutually, Since processing which moves in

the same direction further to the location which avoids interference is performed when it is detected whether it newly interferes with other partial models in the same hierarchy and it has interfered From the three-dimension model which carried out the product design using CAD etc., the drawing in the condition that it has been decomposed and arranged can be created automatically, and a trial-and-error method can be applied, adjusting the migration length of each components which constitute an assembly, and all required count can be automatically performed in that case. moreover, in claim 2 and invention according to claim 7 In invention according to claim 1 or 5 sequentially from a partial model with the deep depth in an assembly hierarchy Since a partial model is moved to the location which avoids interference when the interference condition of the partial models in each hierarchy in a hierarchy is checked and it has interfered Signs that the assembly concerned was decomposed among all components about the whole assembly in the condition which is absolutely none can be drawing[a display and]-ized. moreover, in claim 3 and invention according to claim 8 It is detected by the physical relationship of the boundary boxes from which the interference condition of partial models serves as a rectangular parallelepiped in invention according to claim 2 or 7. Since the direction of the direction of X which hits the shortest side of the interference region of the boundary box, the direction of Y, or a Z direction is made into the model migration direction In case signs that the assembly concerned was decomposed among all components in the condition which is absolutely none can be drawing[a display and]-ized about the whole assembly and a partial model is moved, the migration length can be stopped to the minimum.

[0010] Moreover, in claim 4 and invention according to claim 9, in claim 1 thru/or claim 3, and invention according to claim 6 to 8, since a user can specify the distance which moves each partial model to the 1st time, while a user adjusts extent which decomposes an assembly, a trial-and-error method can be applied. Moreover, since it is automatically determined from the value of the range of the location of the coordinate value when projecting eight coordinate values on the three-dimension space which defines by claim 5 and invention according to claim 10 the boundary box of a partial model to which the distance which moves to the 1st time moves each model in claim 1 thru/or claim 3, and invention according to claim 6 to 8 in the migration direction, an activity becomes easier. Moreover, since the program programmed according to the three-dimension configuration art according to claim 6 to 10 is memorized by the removable storage in invention according to claim 11, for example By equipping information processors, such as a personal computer which was not able to perform three-dimension configuration processing according the storage to invention according to claim 6 to 10 until now Also in the information processor, an effect of the invention according to claim 6 to 10 can be obtained.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] In case partial models, such as components, a subassembly, etc. which constitute the assembly especially, are mutually pulled apart from the condition by which the assembly was carried out and this invention arranges them with respect to the three-dimension configuration art which is enforced with information processors, such as a three-dimension configuration processor, a personal computer, etc. of dedication which perform three-dimension configuration processings, such as three dimensional CAD/CAM/CAE/CG, and which processes the memorized three-dimension geometric model, it relates to the three-dimension configuration art which can arrange easily so that the partial models may not interfere.

[Translation done.]

PRIOR ART

[Description of the Prior Art] By the spread of three dimensional CAD / CG systems, the user layer of the three-dimension configuration data expressing a three-dimension solid configuration is expanded. In recent years, also in creation of the work procedure instruction sheet for verification of simulation or assembly nature, and a still more nearly actual product assembly etc., three-dimension configuration data are utilized effectively. In addition, a three-dimension solid configuration points out the configuration generated as solid model data of for example, a boundary representation format, the field closed on three-dimension space with an element, such as a ridgeline, top-most vertices, and a field, is defined, and the stereo with which contents were got blocked is expressed as the solid model of a boundary representation format. For example, in case the above mentioned assembly procedure is drawn up, it is required to illustrate signs that the subassembly and components which constitute a product have been taken into pieces and arranged at fixed spacing. About such a drawing, the expert has so far created by handicraft from the two-dimensional drawing expressing a three-dimension solid configuration. However, creating the drawing described above by handicraft from the two-dimensional drawing took great cost and time amount. Moreover, when the completed drawing was not a desired thing since it was impossible to have adjusted the distance which moves each components, a view when seeing the model, etc. after a drawing is completed, the drawing had to be re-created from the beginning. Although the method of displaying the result of on the other hand having moved each components using the CAD system used for the product design, and using it for a drawing is also considered, the user (operator) of a CAD system needs to do the activity which takes into pieces each components which constitute a product in that case, and is arranged in a suitable location for every components, and appropriate time amount is required for performing it manually. In addition, by the layout design approach shown in the JP,2000-90129,A official report, an arrangement constraint and the arrangement Ruhr are added to the components information on the components arranged, and it arranges automatically using the information which changed those information into three-dimension configuration data, and it inspects automatically whether the arranged components lap, and further, it arranges automatically so that components may not lap according to the inspection result. Moreover, from this applicant, in case the assembly which carried out the product design using the CAD system etc. is understood by automatic, the automatic decomposition system which took out components automatically through the optimal path is offered so that the components taken out from an assembly location may not collide with a ** assembly.

[Translation done.]

* NOTICES *

EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, according to this invention, in claim 1 and invention according to claim 6 In the three-dimension configuration processing which displays the three-dimension geometric model which consists of two or more partial models according to an indicative data When it moves so that the partial model which the physical relationship of field doubling of partial models or axial doubling is automatically detected, and has it in the physical relationship may be pulled apart mutually, Since processing which moves in the same direction further to the location which avoids interference is performed when it is detected whether it newly interferes with other partial models in the same hierarchy and it has interfered From the three-dimension model which carried out the product design using CAD etc., the drawing in the condition that it has been decomposed and arranged can be created automatically, and a trial-and-error method can be applied, adjusting the migration length of each components which constitute an assembly, and all required count can be automatically performed in that case. moreover, in claim 2 and invention according to claim 7 In invention according to claim 1 or 5 sequentially from a partial model with the deep depth in an assembly hierarchy Since a partial model is moved to the location which avoids interference when the interference condition of the partial models in each hierarchy in a hierarchy is checked and it has interfered Signs that the assembly concerned was decomposed among all components about the whole assembly in the condition which is absolutely none can be drawing[a display and]-ized. moreover, in claim 3 and invention according to claim 8 It is detected by the physical relationship of the boundary boxes from which the interference condition of partial models serves as a rectangular parallelepiped in invention according to claim 2 or 7. Since the direction of the direction of X which hits the shortest side of the interference region of the boundary box, the direction of Y, or a Z direction is made into the model migration direction In case signs that the assembly concerned was decomposed among all components in the condition which is absolutely none can be drawing[a display and]-ized about the whole assembly and a partial model is moved, the migration length can be stopped to the minimum.
[0010] Moreover, in claim 4 and invention according to claim 9, in claim 1 thru/or claim 3, and invention according to claim 6 to 8, since a user can specify the distance which moves each partial model to the 1st time, while a user adjusts extent which decomposes an assembly, a trial-and-error method can be applied. Moreover, since it is automatically determined from the value of the range of the location of the coordinate value when projecting eight coordinate values on the three-dimension space which defines by claim 5 and invention according to claim 10 the boundary box of a partial model to which the distance which moves to the 1st time moves each model in claim 1 thru/or claim 3, and invention according to claim 6 to 8 in the migration direction, an activity becomes easier. Moreover, since the program programmed according to the three-dimension configuration art according to claim 6 to 10 is memorized by the removable storage in invention according to claim 11, for example By equipping information processors, such as a personal computer which was not able to perform three-dimension configuration processing according the storage to invention according to claim 6 to 10 until now Also in the information processor, an effect of the invention according to claim 6 to 10 can be obtained.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, the layout design approach shown in the JP,2000-90129,A official report is an approach for an assembly, and cannot be used about interference of the subassembly in the location which took into pieces the assembly in the condition of having been assembled, on a subassembly or components level, or components. Moreover, that said automatic decomposition system also arranges the disassembled components (it took into pieces) **** does not carry out. Therefore, it sets to the former despite a join office. As the drawing in the condition of having taken into pieces and arranged components will be referred to as creating by handicraft and was described above in that case There is a problem of taking great cost and time amount, and after a drawing is completed, there is a problem that it is impossible to adjust the distance which moves each components, a view when seeing the model, etc. The purpose of this invention is to solve the problem of such a conventional technique, and, specifically, it is from the three-dimension model which carried out the product design using CAD etc. to offer the three-dimension configuration art which can create automatically the drawing in the condition of having been decomposed and arranged. Moreover, a trial-and-error method can be applied adjusting the migration length of each components which constitute an assembly, and it is in offering the three-dimension configuration art which can perform all required count automatically in that case.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to solve the aforementioned technical problem, in invention according to claim 1 In the three-dimension configuration processor which displays the three-dimension geometric model which consists of two or more partial models according to an indicative data A model migration means to move so that the partial model which detects automatically the physical relationship of field doubling of partial models or axial doubling, and is in the physical relationship may be pulled apart mutually, When detecting whether it newly interferes with other partial models in the same hierarchy and having interfered in it in the case of the partial model migration by the model migration means, it is characterized by having a migration addition means to perform processing which moves in the same direction further to the location which avoids interference. Moreover, in invention according to claim 2, in invention according to claim 1, the interference condition of the partial models in each hierarchy in an assembly hierarchy is checked in order from a partial model with the deep depth in an assembly hierarchy, and when having interfered, it is characterized by constituting said model migration means so that a partial model may be moved to the location which avoids interference. Moreover, in invention according to claim 3, in invention according to claim 1 or 2, the physical relationship of boundary boxes used as a rectangular parallelepiped detects the interference condition of partial models, and it is characterized by having a migration direction decision means to determine the direction of the direction of X which hits the shortest side of the interference region of the boundary box, the direction of Y, or a Z direction as the model migration direction. Moreover, in invention according to claim 4, it is characterized by having a distance assignment means for a user specifying the distance which moves each partial model to the 1st time in claim 1, claim 2, or invention according to claim 3. Moreover, it is characterized by making eight coordinate values on the three-dimension space which defines by invention according to claim 5 the boundary box of a partial model which moves the distance which moves each model to the 1st time in claim 1, claim 2, or invention according to claim 3 the configuration for which it opts automatically from the value of the range of the location of the coordinate value when projecting in the migration direction.
[0005] Moreover, it sets to the three-dimension configuration art which displays the three-dimension geometric model which consists of two or more partial models in invention according to claim 6 according to an indicative data. When it moves so that the partial model which detects automatically the physical relationship of field doubling of partial models or axial doubling, and is in the physical relationship may be pulled apart mutually, When detecting whether it newly interferes with other partial models in the same hierarchy and having interfered in it, it is characterized by making it the configuration which performs processing which moves in the same direction further to the location which avoids interference. Moreover, in invention according to claim 7, in invention according to claim 5, the interference condition of the partial models in each hierarchy in a hierarchy is checked in order from a partial model with the deep depth in an assembly hierarchy, and when having interfered, it is characterized by making it the configuration which moves a partial model to the location which avoids interference. Moreover, in invention according to claim 8, in invention according to claim 7, the physical relationship of boundary boxes used as a rectangular parallelepiped detects the interference condition of partial models, and it is characterized by making the direction of the direction of X which hits the shortest side of the interference region of the boundary box, the direction of Y, or a Z direction the configuration determined as the model migration direction. Moreover, in invention according to claim 9, it is characterized by

making distance which moves each partial model to the 1st time the configuration which a user can specify in claim 6, claim 7, or invention according to claim 8. Moreover, it is characterized by making eight coordinate values on the three-dimension space which defines by invention according to claim 10 the boundary box of a partial model which moves the distance which moves each model to the 1st time in claim 6, claim 7, or invention according to claim 8 the configuration for which it opts automatically from the value of the range of the location of the coordinate value when projecting in the migration direction. Moreover, in invention according to claim 11, it is characterized by memorizing the program programmed according to the three-dimension configuration art according to claim 6 to 10 in the storage which memorized the program.

[0006]

[Embodiment of the Invention] Hereafter, a drawing explains the gestalt of operation of this invention to a detail. Drawing 1 is the hardware configuration Fig. of the three-dimension configuration processor with which this invention is carried out. As illustrated, this three-dimension configuration processor The three-dimension configuration processing concerning this invention, and control of this whole equipment CPU1, and the program and data which are performed according to a program The memory memorized temporarily (For example, RAM) 2, a program, and data The display 5 which displays partial models, such as a subassembly, components, etc. with which the model of the external storage (for example, hard disk drive unit) 3 to memorize, the input device 4 which inputs actuation information and three-dimension configuration data, and the three-dimension solid configuration by which the assembly was carried out, and it were decomposed, and them It has the bus 6 connected like illustration. Moreover, drawing 2 is the system configuration Fig. of a three-dimension configuration processor important section showing one example of this invention. As illustrated, this three-dimension configuration processor Said hardware and program realize, respectively. Partial models, such as a subassembly and components, are pulled apart from the input section 11 into which actuation information and three-dimension configuration data are made to input, the shape memory Management Department 12 which three-dimension configuration data are stored in external storage 3, or manages three-dimension configuration data, and the condition by which the assembly was carried out. It has the configuration display 14 on which partial models, such as a subassembly, components, etc. with which the model of the model migration processing section 13 to which it is made to move, and the three-dimension solid configuration by which the assembly was carried out, and it were decomposed, are displayed. In addition, in this example, a model migration means given in a claim, a migration addition means, and the migration direction decision means are realized by said model migration processing section 13, and a distance assignment means is realized by the input section 11.

[0007] The flow of this example of operation performed with such a three-dimension configuration processor by drawing 3 is shown. Hereafter, actuation of this example is explained according to drawing 3 . First, it detects whether the model migration processing section 13 has the physical relationship of field doubling or axial doubling among components, for example about two or more components with common parents (subassembly) (S1). In addition, what is necessary is just to use the method of judging whether the flat surface which has a normal vector in the physical relationship which shares the part or whole between the reverse sense in three-dimension space exists generally learned, in order to detect that components are in the physical relationship of field doubling. Moreover, what is necessary is just to use how the cylinder side whose shaft corresponds on three-dimension space, a conical surface, or a radii ridgeline exists, in order to detect that components are in the physical relationship of axial doubling. And if the components in the physical relationship of field doubling or axial doubling are detected (it is YES at S2), the model migration processing section 13 will move a partial model (this example components) to that normal vector and shaft orientation (S3). In addition, a user may be make to give migration length beforehand by the input section 11, and it may be automatically determine from the die length of the range of the coordinate value in the projecting plane when project the coordinate value on the three dimension space of eight points which constitute the boundary box (rectangular parallelepiped circumscribe to the component concerned) of the components which move in the migration direction. That is, movement magnitude is enlarged, so that the components which move are large. After moving each partial model, the model migration processing section 13 detects whether it is newly interfering with other partial models (a subassembly and components) with common parents (it laps) (S4). And

when having interfered, a model is further moved in the same direction by (S4 to YES) and the location in which it stops interfering (S5).

[0008] The flow of operation which carries out the above processing (it is called automatic components migration) to the whole assembly hierarchy to drawing 4 is shown. In addition, the depth is the semantics of the number of hierarchies until it results from root in an assembly hierarchy tree (for example, the top assembly) to the node (the subassembly concerned or components) in the following explanation. Moreover, that the depth is deep means that the long distance from root and the number of hierarchies are size in a hierarchy tree. As shown in drawing 4 , automatic components migration is first carried out from the subassembly (hereafter referred to as A) containing the components which exist in the location of the leaf of the deepest part with which sequence serves as the beginning, in view of the order when searching a depth first (deep order) for an assembly hierarchy tree (S11). Moreover, when the subassembly (hereafter referred to as B) located in one high order of A is observed and the subassembly and components other than A exist under B, automatic components migration is similarly performed about those subassembly and components (S11). In this way, when automatic components migration of all the partial models (a subassembly and components) contained in B is completed, it detects whether boundary boxes interfere about all those partial models (S12). And when there is a partial model in which it has interfered, it moves so that YES) and partial models may not interfere by (S13 (S14). About the decision of the direction from which selection of the partial model which moves, and its partial model are moved, you may process so that two models may always be pulled apart, for example in the direction of X, and it hits the shortest side among three sides of the interference region (this is a solid field) of the boundary box used as a rectangular parallelepiped. X, Y, or Z A model may be moved to a direction. By the latter approach, the migration length of a partial model can be pressed down to the minimum, avoiding interference. When there is a subassembly (hereafter referred to as C) located in one high order of B and subassemblies other than B exist under C, automatic components migration is completely similarly carried out from the subassembly which contains the components located in the deepest part under it within the configuration excluding B from the subtree which assumed NO) and C to be root by (S15 (S11-S14). Moreover, processing will be ended, if it processes as mentioned above and even an assembly hierarchy's most significant is reached (it is YES at S15). In this way, according to this example, it becomes possible by processing following a hierarchy to display signs that the assembly concerned has been decomposed and arranged, in the condition that there is none of all interference among all components over the whole assembly. In addition, it is also possible to output signs that the assembly concerned has been decomposed and arranged in the paper by the plotter. As mentioned above, although one example of this invention was explained, also in the information processor, three-dimension configuration processing by this invention can be performed by memorizing the program programmed according to a three-dimension configuration art which was explained, for example to a removable storage, and equipping information processors, such as a personal computer which was not able to perform three-dimension configuration processing according the storage to this invention until now. Moreover, also in the information processor, three-dimension configuration processing by this invention can be performed by transmitting to the information processor which was not able to perform three-dimension configuration processing according said program to this invention until now through a network.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the hardware configuration Fig. of the three-dimension configuration processor with which this invention is carried out.
[Drawing 2] It is the system configuration Fig. of a three-dimension configuration processor important section showing one example of this invention.
[Drawing 3] It is the flow Fig. of a three-dimension configuration art of operation showing one example of this invention.
[Drawing 4] They are other flow Figs. of a three-dimension configuration art of operation showing one example of this invention.
[Description of Notations]
1 CPU
3 External Storage
4 Input Unit
5 Display
11 Input Section
13 Model Migration Processing Section
14 Configuration Display

[Translation done.]

* NOTICES *

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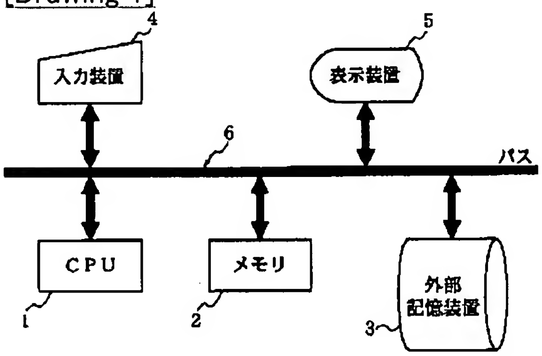
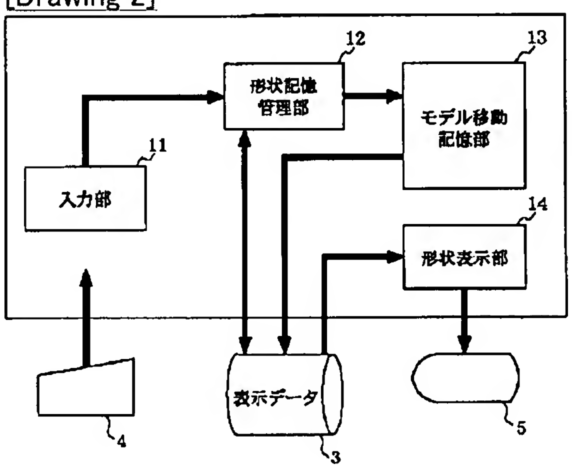
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

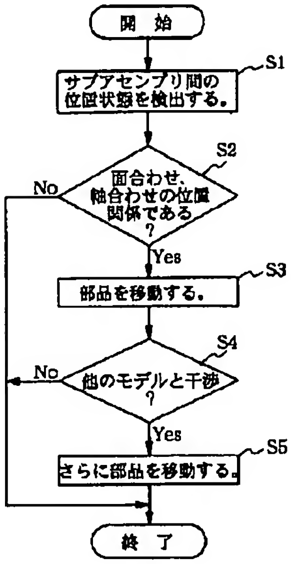
[Drawing 1]



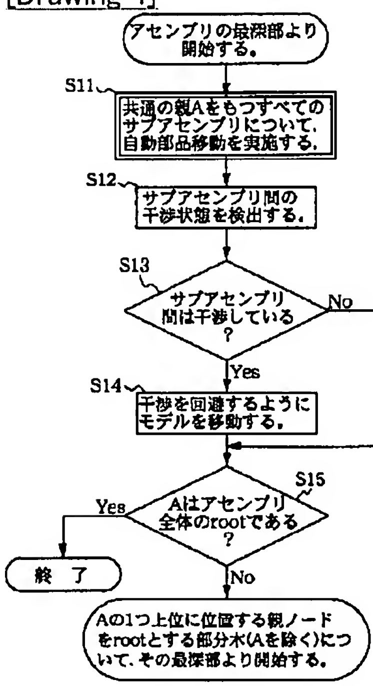
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]